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ABSTRACT

The Third International Mathematics and Science Study (TIMSS) is the largest, most comprehensive, and most rigorous international comparison of education ever undertaken. TIMSS findings show similarities and differences in the processes and outcomes of schooling between the United States and East Asian countries, particularly Japan. This report reviews the initial findings from the TIMSS eighth-grade report, with a special focus on the United States and Japan, and discusses missing or incomplete links in international education studies. The initial findings highlight similarities between students' learning experiences at home and critical differences between those at school. These patterns imply that Japanese and U.S. students do not differ in out-of-school learning experiences, but there are differences neglected in TIMSS highlights, such as private tutoring. On the other hand, TIMSS researchers found substantial differences in the content and process of instruction at school and differences in instructional organization. While initial TIMSS findings show that the United States is still far from achieving the national goal of being first in the world in mathematics and science, these aggregate national patterns ignore the enormous local variation in the U.S. It is not clear whether federated countries like the United States are really comparable to other countries. For a valid comparison of the United States with highly centralized East Asian countries, it is suggested that the American states be treated as comparable national units. For a reliable comparison of the countries over time, it is suggested that current practices and outcomes be compared to past counterparts. something that will take into account the possibility of educational convergence between the United States and East Asian countries. To make fair, valid, and reliable comparisons, future international education studies need to take into account the linkages between formal and informal learning, consider local variation within a country, and compare current and past practices and outcomes. (Contains 1 figure, 1 table, and 33 references.) (SLD)

Missing Links in International Education Studies:
Comparing the U.S. with East Asian Countries in TIMSS

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Paper presented at the Annual Meeting of the AERA (San Diego, CA, April 13, 1998)

Introduction

The Third International Mathematics and Science Study (TIMSS) is the largest, most comprehensive, and most rigorous international comparison of education ever undertaken. The TIMSS results show us where U.S. education stands not only in terms of academic achievement, but also in terms of the curriculum and instruction that students receive (See Beaton et al., 1996a, 1996b; Howson, 1995; Schmidt et al., 1996). Indeed, Pursuing Excellence, a series of reports published by the National Center for Education Statistics provide a rich synthesis of the findings from TIMSS on U.S. fourth-grade, eighth-grade, and twelfth-grade mathematics and science education, and thus has attracted nationwide media coverage and public attention.

The TIMSS findings show similarities and differences in the processes and outcomes of schooling between the U.S. and East Asian countries, particularly Japan. On the one hand, American education policy over the last decade seemed to follow the East Asian schooling model that fulfills higher and tougher education standards for all students (see Carnegie Forum on Education and the Economy, 1986; National Commission on Excellence in Education,1983). On the other hand, researchers explained the learning gap between the U.S. and East Asian countries in terms of the different institutional or cultural conditions that support the systemic implementation of education standards in each country. This includes differences in (1) curricular governance systems; and (2) parental values and student attitudes (see Stevenson & Baker, 1991; Stevenson & Stigler, 1992).

While large-scale international studies such as the TIMSS are not designed to address particular issues in individual countries, they often have far-reaching implications for national education policy and research beyond

the original scope of analysis. For the comparison of the U.S. with Japan or East Asian countries in general, the initial findings from the TIMSS show that some important linkages were neglected. First, the TIMSS focuses on formal education without paying attention to the linkages between schooling and out-of-school learning experiences. Second, the TIMSS reports aggregate national patterns while neglecting local variation. Third, the TIMSS focuses on the current status of educational practices and outcomes without paying attention to linkages with past practices and outcomes. In light of these concerns, I will review the initial findings from TIMSS 8th grade report (NCES, 1996) with special focus on the cases of the U.S. and Japan, and discuss missing or incomplete links in international education studies.

Linkages between formal education and out-of-school learning

The initial findings from the TIMSS analysis of the U.S. and Japan highlight similarities between students' learning experiences at home but critical differences between those at school. On the one hand, the TIMSS researchers found that students in both countries spend a relatively comparable amount of time on self-study and in leisure activities after school. First, Japanese and U.S. students spend between 30 minutes and an hour studying math outside of school, and about the same amount studying science. Second, heavy TV watching is as common among U.S. eighth graders as it is among their Japanese counterparts.

These patterns imply that Japanese students do not differ from U.S. counterparts in out-of-school learning experiences. However, there are differences neglected in the TIMSS highlights. After-school private tutoring

practices (juku) that complement formal schooling or prepare students for high-stakes exams are pervasive in Japan (see Goya, 1993; Harnish, 1994; Rohlen, 1980). This is also the case for many other Asian nations that outperform the U.S. in mathematics and science, including Korea, Singapore, and Taiwan. A national survey of Korean middle/high school students shows that the average student receives about 7 hours of tutoring services every week (Shin et al., 1991).[1] As shown in Table 1, the survey also shows that the perceived effectiveness of private tutoring is overwhelming and that this perception motivates students to undertake private tutoring.

Table 1. Frequency and Percentage of Korean Students Reporting the Effectiveness of Private Tutoring

		How Much Help Do (Did) You Receive from Private Tutoring in Improving Your Academic Achievement (College Entrance)?			
		No/Little	Some	Great	
		N (Row %)	N (Row %)	N (Row %)	Total
Type of	Middle School	59 (4.9)	665 (54.7)	492 (40.5)	1216
Survey	High School	51 (10.7)	306 (62.2)	133 (27.0)	460
Respondents	College Freshman	75 (18.9)	226 (57.0)	96 (24.2)	397

According to the NCES report, sixty-four percent of Japanese eighth graders reported attending weekly extra lessons in math, and 41 percent in

science (NCES, 1996). In contrast, a quarter of the students in the U.S. reported that they worked at a paid job before or after school. Consequently, the exclusive focus on students' reports about their learning experiences at home obscures substantial differences in the type of additional learning opportunities available to students.

On the other hand, the TIMSS researchers found substantial differences in the content and process of instruction at school. The content taught in U.S. eighth-grade math classrooms is at a seventh-grade level in comparison with Japan. Moreover, the pedagogy in the U.S. classrooms also differed significantly from that of Japanese classrooms. American teachers emphasizes skill acquisition, whereas Japanese teachers focus on understanding. When we shift our attention to out-of-school learning, classroom pedagogy in Japan is seen in a different light. As the NCES report notes, private tutoring in Japan focuses on the review and practice of basic skills (NCES, 1996). This dual system of learning assists slower students who need to review prior material, and provides all students with extra practice on concepts taught in the classroom.

The TIMSS researchers also note differences in instructional organization. In the U.S., eighth-grade students of different abilities are typically divided into different classrooms, whereas there is no ability grouping in Japan at this grade level. However, this contrast ignores the fact that juku sorts Japanese students into ability groups and provides differential curriculum. In fact, the content of the courses provided at the juku ranges from remedial to highly accelerated (White, 1987). Further, the opportunity to take advantage of private lessons differ among students from different socioeconomic backgrounds. Thus, juku, or private after-school class tutoring,

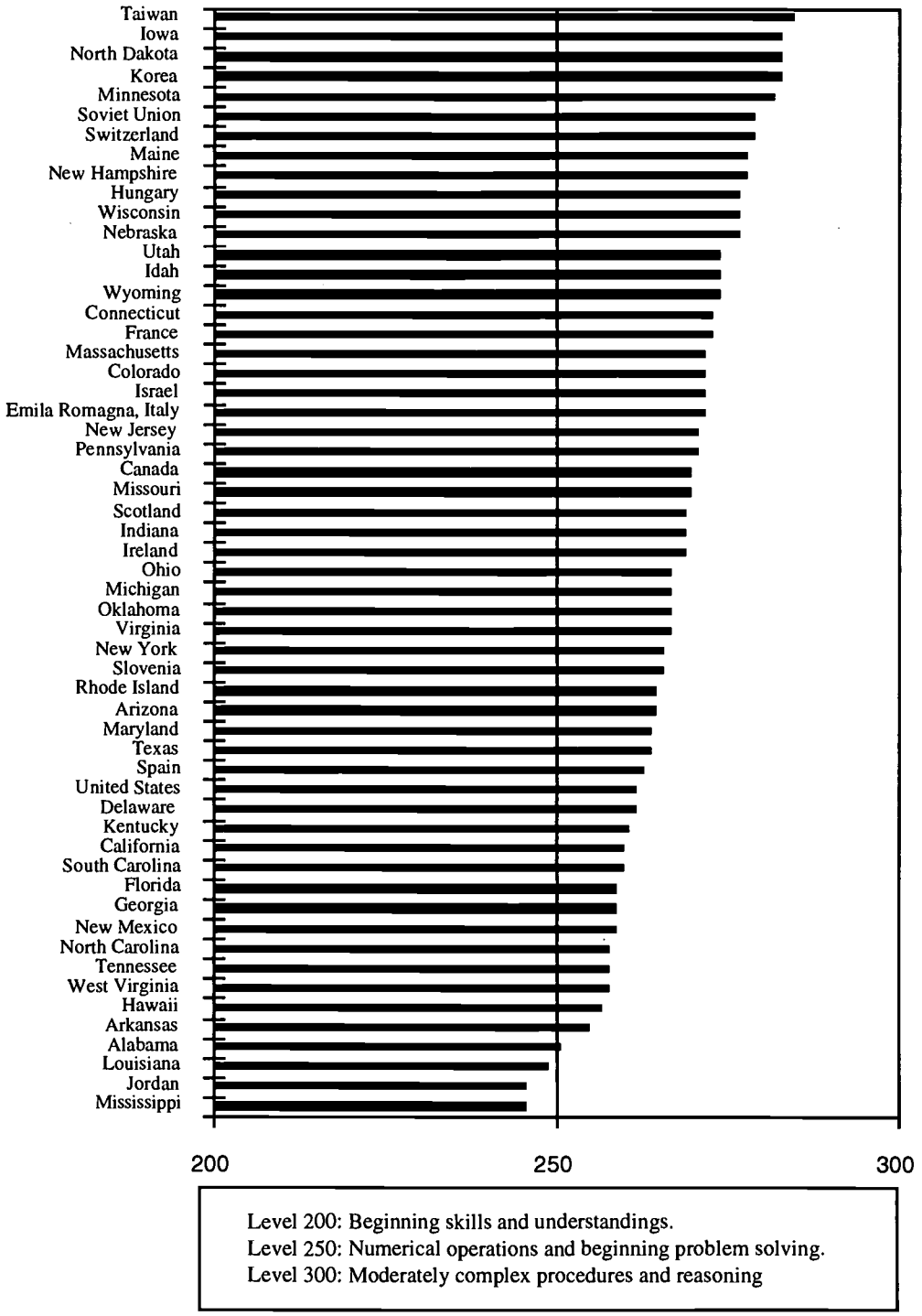
reinforces the principle of competitive selection while egalitarianism is upheld through the formal schooling process.

Linkages between aggregate national pattern and local variation

Initial findings from TIMSS on U.S. eighth-grade mathematics and science education show that the U.S is still far from achieving the national goal of being first in the world in mathematics and science achievement by the year 2000 (NCES, 1996). In TIMSS mathematics, the U.S. eighth graders scored below the international average. This result, however, may not surprise people who are acquainted with previous international surveys of achievement such as the International Association for the Evaluation of Educational Achievement (IEA) in the 1960s and 1980s, and the International Assessment of Educational Progress (IAEP) in the early 1990s that showed basically the same results (see Raizen and Jones, 1985; McKnight et al., 1987; Educational Testing Service, 1989).

However, these aggregate national patterns ignore enormous local variation in the U.S. Most American states are not only comparable to many countries in size or population, but each state is also responsible for its own educational system, similar to the way in which most other national governments are responsible for the educational system. In fact, previous comparison of individual states with other nations showed that not all U.S. school systems are alike, and that differences in achievement exist among the American states that are as great as the differences among the countries examined (see Beaton & Gonzalez, 1993; Salganik et al., 1993).[2] Figure 1 shows

Figure 1. Mathematics proficiency scores for 13-year-olds in countries and public school 8th grade students in states, by country (1991) and state (1992)



Source: Educational Testing Service, IAEP/NAEP Cross-linking Study, 1993; U.S. Department of Education, National Center for Education Statistics, NAEP 1992 Mathematics Report Card for the Nation and the States, 1993.

that the highest performing states in the U.S. (e.g., Iowa, North Dakota, and Minnesota) perform as well as the highest performing countries (e.g., Taiwan and Korea), whereas the lowest performing states in the U.S. perform as poorly as the lowest performing countries in the world. In addition to national assessment, the U.S. TIMSS offered states the opportunity to assess a state-representative sample of their students. However, the state participation rate was very low because individual states were responsible for all costs associated with State TIMSS: Colorado, Illinois, and Minnesota joined in this program.

The term curriculum framework has recently been used in national and international studies aimed at a broad analysis of curriculum across schools, districts, states or countries. The National Assessment of Educational Progress (NAEP) is now written and conducted based on a content framework that is developed by a consensus panel of subject experts, educators, and researchers (CCSSO, 1991; National Assessment Governing Board, 1994). At the same time, the Third International Mathematics and Science Study (TIMSS) is based on mathematics and science frameworks developed by an international consensus among scientists, mathematicians, educators, and researchers from participating countries (Robitaile et al., 1993).

Notwithstanding a growing national and international consensus around curriculum and instruction in core academic subjects, it remains dubious whether federated countries like the U.S. are comparable to others. The TIMSS researchers found that the U.S. curriculum is less focused and less advanced than the Japanese curriculum. They also found that lessons with high-quality mathematical reasoning are a rare phenomenon in the U.S. These national aggregate patterns, however, may obscure the fact that in the U.S., states play independent roles in developing and implementing

curriculum. With the publication of the National Council of Teachers of Mathematics (NCTM) Curriculum and Evaluation Standards for School Mathematics (1989), many states worked on ways to represent the Standards in state curriculum frameworks (Blank and Dalkilic, 1992). A recent study found that the substance of such newly developed or revised curriculum frameworks vary widely among states (Blank and Pechman, 1995). Thus, the state as the unit of analysis seems to be more appropriate than the nation when examining curriculum.

Linkages between current and past educational practices and outcomes

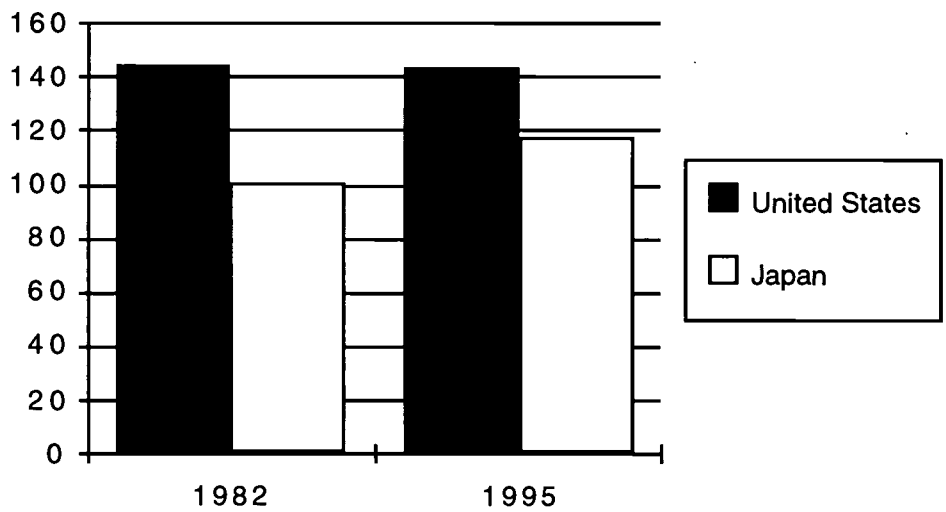
A rough comparison of TIMSS results with previous IEA/IAEP results indicates that U.S. eighth graders' overall standing in math has hardly improved relative to their international counterparts (NCES, 1996). Despite the seemingly persistent learning gap between the U.S. and other industrial countries, reliable international comparisons over time are difficult because the assessments are based on different instruments and populations. Achievement in TIMSS was initially intended to be linked with the results of two earlier IEA studies, that is, the Second International Mathematics Study (SIMS) and the Second International Science Study (SISS). However, formal links between TIMSS and SIMS were never realized because the target populations were not equivalent (Garden & Orpwood, 1996). Consequently, the lack of linkages between the TIMSS and its antecedents deprived researchers of the opportunity to systematically examine whether there have been significant changes in educational processes and outcomes during the interim period.

While cross-sectional studies using large-scale international databases have been concerned primarily with the comparison of current educational practices and outcomes, another branch of international studies focused on institutional changes across national school systems. This research observed a global convergence in both educational ideology and educational structure (see Meyer et al., 1979; Ramirez and Boli, 1987). For example, many countries have addressed similar issues using different labels such as educational excellence, productivity, efficiency, and accountability. Additionally, global school reform over the last decade seem to have been shaped by two sets of forces. One is growing public distrust of school bureaucracy in a climate of rapid political change (Wong, 1994). The other is growing international competition in the context of the global economy (Kearns and Doyle, 1991).

The consequences of these factors for education policies have varied between countries according to their educational conditions and problems. Indeed, the U.S. and Japan took quite contrasting approach to school reform during the 1980s and early 1990s. In the U.S. where low educational expectations and achievement were identified as central problems, efforts were made to set higher education standards and require stronger school accountability (see Ravitch, 1995). These policies, which have emerged since the 1983 national report A Nation at Risk, culminated with the 1989 national education goals (enacted into the Goals 2000 in 1994). In contrast, Japan identified the problem as uniform control and excessive competition, resulting in the lack of a humane education. To address this issue, the National Commission on Educational Reform, established by the government in 1984, made efforts to individualize the curriculum and diversify the schools (see Lincicombe, 1993).

Assuming that national reform policies promote systemic change, one may hypothesize that the past gap in classroom learning opportunities between the two industrial countries has narrowed as a result of their different reform paths. For example, increased instructional time and homework assignment was likely to be promoted in the U.S., whereas the opposite was likely to happen in Japan. In this regard, some of the TIMSS results that appear contrary to popular beliefs are noteworthy.

Figure 2. Hours of Mathematics Instructional Time Per Year for Eighth-Graders based on the SIMS (1982) and TIMSS (1995) Reports



Note. The 1982 SIMS results involve eighth grade in U.S. but seventh grade in Japan.

First, U.S. eighth graders tend to spend more hours per year in math and science classes than Japanese students. Nevertheless, the previous comparison based on the SIMS results (McNight et al., 1987) showed that the U.S. exceeded Japan in terms of instructional time in mathematics even back in 1982 (see Figure 2). Thus, there is no evidence that as a result of national school reforms Japanese students get assigned relatively small amount of

instructional time on math while American students get more of math instruction.

Second, Japanese teachers tend to assign less homework than U.S. teachers.[3] Having found that Japanese teachers assigned less homework than U.S. teachers, but at the same time Japanese students reported that they studied about as much as their U.S. counterparts, the authors of Pursuing Excellence ask how Japanese students were motivated and supported in this extra work and seem to seek its answer in the exigency of high school entrance examinations for Japanese 8th graders (NCES, 1996). By linking these and other TIMSS results to their counterparts from previous international studies, we may be able to explore the potential of educational changes that are related to school reform policies.

Conclusion

The initial findings from TIMSS strongly suggest that substantial differences in the quality of curriculum and instruction account for the learning gap between the U.S. and East Asian countries, particularly Japan. Despite the relevance of school-related findings to international comparisons, the exclusive focus on formal schooling may ignore the supplementary function of informal education. For a fairer comparison of U.S. and East Asian education, I suggest a closer look at the role of after-school private tutoring practices in East Asian countries. At the same time, the exclusive attention to national comparisons may obscure the size of local variation in different countries. For a valid comparison of the U.S. with highly centralized East Asian countries, I suggest the American states be treated as comparable

national units. Finally, the exclusive concern with the current status of educational practices and outcomes may detract our attention from an examination of dynamic changes in each country. For a reliable comparison of the countries over time, I suggest a comparison of the current practices and outcomes to the past counterparts. This will take into account the possibility of educational convergence between the U.S. and East Asian countries that result from their quite different reform paths.

Indeed, these problems are not unique to the U.S. and East Asian countries in TIMSS analysis. In an attempt to make data collection more efficient or to make research findings more generalizable, any large-scale international assessment studies are likely to introduce certain biases in their research agenda. To insure fair, valid, and reliable comparisons, future international education studies need to take into account the linkages between formal and informal learning, consider local variation within a country, and compare current with past practices and outcomes. In the meantime, researchers who analyze large-scale international assessment data as well as the policy community who utilize the research findings need to be more aware of the limitations of the currently available information.

Notes

[1] It is also noteworthy that private expenditures on tutoring is often greater than public school expenditures, despite the fact that students spend much more time on school learning than on tutoring: Last year, Koreans spent $25 billion or fully 150 % of the government's education budget on private tutoring (Asia Week, 1997).

[2] This comparison was made possible through an experimental linking of state-by-state assessment data (NAEP TSA) with international assessment data (IAEP). However, these data bases are not aligned with each other to allow for the formal equating and rigorous comparisons between the U.S. states and the IAEP nations (see Linn & Baker, 1995).

[3] 86 percent of U.S. mathematics teachers assigned 3 to 5 times per week in comparison to 21 percent of Japanese teachers. But the typical amount of homework assignment was about thirty minutes or less in both countries.

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